Issued: November 21, 2007

Southwest Climate Outlook

The University of Arizona

Source: USDA Forest Service - Prescott National Forest

Photo Description: On October 30, a human-caused fire was started in the Prescott National Forest 10 miles south of Prescott, Arizona. This photo was taken on November 4 and shows an Airtanker dropping fire retardant.

Would you like to have your favorite photograph featured on the cover of the *Southwest Climate Outlook*? For consideration send a photo representing Southwest climate and a detailed caption to: knelson7@email.arizona.edu

In this issue...

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November Climate Summary

Drought – Short-term drought conditions continued to improve slightly across Arizona due to some early fall precipitation while conditions across northeastern New Mexico have continued to worsen. The National Drought Monitor continues to show moderate to severe drought across much of Arizona. An expansion of abnormally dry conditions into New Mexico is due to below-average precipitation levels persisting over the past several months.

Temperature – Temperatures across Arizona and New Mexico have been above average for the past thirty days. Arizona has been especially warm, with temperatures ranging from 4 to 6 degrees F above average. New Mexico temperatures were generally 2 to 4 degrees F above average.

Precipitation – Both Arizona and New Mexico observed much below-average precipitation over the past thirty days. Most locations in Arizona and New Mexico saw less than 25 percent of average precipitation for the period.

Climate Forecasts – Seasonal climate forecasts paint the Southwest with an above-average temperature and below-average precipitation forecast through the fall and into the winter season. The current La Niña event is to blame for the below-average precipitation forecast and, in part, for the above-average temperature forecast.

The Bottom Line – La Niña continues to be the big story this month with the prospect of below-average precipitation amounts plaguing the Southwest this upcoming winter. The fall dry spell has continued across Arizona and New Mexico over the past month and may continue into the winter with La Niña. This is prompting concerns of expanding and deepening drought conditions across both Arizona and New Mexico.

630-acre fire in Prescott National Forest

The human-caused August Fire, which scorched 630 acres in the Prescott National Forest in early November, has revived concerns about fire potential—even this late in the year. Some measures of fire potential show low fuel moisture and high potential for fire spread, given an ignition, due to warm and dry winter conditions associated with the La Niña episode developing in the tropical Pacific Ocean.

The most recent fire potential outlook for the Southwest, issued by the National Interagency Coordination Center, cautions that abundant dry grasses and other fine fuels, combined with more frequent-than-usual down-slope wind events, will keep fire potential above normal across the eastern plains of New Mexico into early winter. A new outlook will be issued on December 3.

For more information visit: http://www.nifc.gov/nicc/predictive/outlooks/monthly_seasonal_outlook.pdf...

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Roundtable discussion on La Niña episode

The El Niño Southern Oscillation (ENSO) forecasts issued this fall by the International Research Institute for Climate and Society (IRI) and the November 8 NOAA Climate Prediction Center Diagnostic Discussion indicated a strong probability that La Niña conditions will continue through early 2008. Models also suggested that the event may strengthen to moderate levels through late fall, dampening hopes for at least normal precipitation in the Southwest this winter season. La Niña events typically disrupt the winter storm track across the western U.S., bringing persistent precipitation to the Northwest and dry conditions to the Southwest. If this scenario plays out, the development of drought impacts across Arizona and New Mexico may continue to expand as snowpack totals dwindle.

On November 6, CLIMAS sought the expertise of scientists who discussed the current La Niña event and its potential fate and impacts in the West and Southwest. The following is a condensed version of that discussion. Some definitions and explanations are included within the discussion. Please see the CLIMAS online glossary (http://www.ispe.arizona.edu/climas/forecasts/glossary.html) for terms that are not defined here.

Roundtable participants:

Christopher Castro, PhD
Assistant Professor, Atmospheric Sciences
The University of Arizona, Tucson

David Gutzler, PhD
Professor, Earth and Planetary Sciences
University of New Mexico, Albuquerque

Klaus Wolter, PhD
Meteorologist, Climate Diagnostics Center, Boulder;
Research Associate, University of Colorado

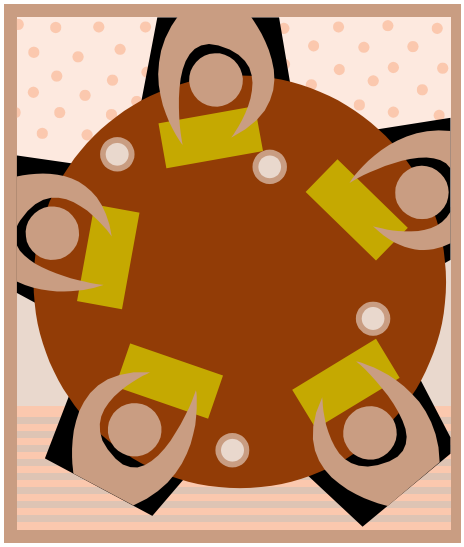
Gregg Garfin, PhD
Roundtable Moderator
Deputy Director of Outreach, Institute for the Study of Planet Earth, The University of Arizona, Tucson

Garfin: La Niña means dry conditions in the Southwest. Is there anything unusual we should expect from this developing La Niña episode?

Wolter: I should preface with the fact that this La Niña started a few months later than expected… and it is actually, in my book, one of the bigger [La Niña] events we have seen, especially in the last thirty years or so.….It should be a pretty standard and moderate, maybe moderate to strong, event that's unfolding.

Gutzler: We've seen some events in the last few years, in this century really, where ocean temperature anomalies seem to have been strongest out near the dateline or really off-shore, and so far the anomalies we're seeing are farther toward the South American coast. In that respect, this event, at least to date, looks like some of the early El Niño/La Niña composites that were developed back in the 80s and early 90s, more so than some of the recent events. If that's a guide, then we might expect a somewhat more typical La Niña response compared to recent events, which haven't really all conformed to the nice composite picture that was developed a couple of decades ago. [A composite is a graphic showing the average of conditions for selected periods of time over a certain space. In this case, it refers to both the progression of the average of the sea surface temperatures in the equatorial Pacific Ocean during a La Niña episode, and to the average of the precipitation deficits and temperature increases in the Southwest associated with a La Niña episode in the Pacific Ocean.]

Castro: With respect to actual precipitation anomalies, we can just go ahead and look at the climate variations in our forecast, and it's a classic La Niña-like signal in the precipitation forecast. From what I've looked at, that signal seems to hold through the fall and winter, and into the next spring.



Garfin: Staying on that note of precipitation anomalies within the region, there's a hint that in January, February, and March, probabilities [for precipitation] become greater for New Mexico than Arizona. What's really driving that, and how much can we depend upon that sort of shift from Arizona to New Mexico in the precipitation anomalies?

Wolter: I'm updating my forecast and I have grim news. My actual forecast, which depends on much more than La Niña, is very pessimistic. I've never seen a regional seasonal forecast this dry in the outlook. I hate to point out that that's actually consistent with a couple of forecasts. ….Usually the mountains in northern Utah, Colorado, and southwestern Wyoming do reasonably well in mid-winter with the La Niña-type storm track. What these forecasts seem to point out is the potential that the storm track may not be quite as pronounced. La Niña itself seems to be on track to do its thing, but there seems to be some competing influences that are pointing a bit towards a drier scenario, unfortunately. In regard to Arizona versus New Mexico, I don't really see much difference there… The tools are pointing towards dryness. …It seems that with at least some tools, and that includes forecast systems from the CPC

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Roundtable, continued

[Climate Prediction Center] and my own updated forecast, March is predicted to be so dry that it more than cancels out any normal wet January or February. But the zero line, the line of equal probability for at or above or below normal, seems to be shifted a bit further toward the north than is typical for La Niña. That would include quite a bit of the Upper Colorado River Basin, with the possible exception of Wyoming. [Upper Colorado River Basin snowpack, and hence spring Colorado River streamflow that supplies water to the Southwest, may suffer from a La Niña storm track that is even more northern than average for La Niña winters.]

Castro: Where we need to start expecting the big change with respect to precipitation, in terms of the anomalies, is not going to happen until the monsoon. We'll have to wait until June or early July for that.

Garfin: I presume you were referring to the tendency for the monsoon precipitation to be above average following a La Niña winter?

Castro: Right. This summer was sort of a good example of that, at least in Tucson. It was a pretty wet July with a lot of upper-level disturbances responsible for the rainfall.

Wolter: One window of opportunity where the midwinter precipitation might try to catch up a bit is usually from about Christmas to mid-February. It seems like with the La Niña pattern there's typically a storm track that comes in from the Pacific Northwest in January, and sometimes these storms dip all the way into, say, northern Arizona. That's something to watch for. If that really happens, maybe this is a more typical La Niña. If it doesn't happen, then my dry outlook will really be on track.

Gutzler: There's another signal of La Niña that may come into play if we're thinking about streamflows next year, and that is the tendency for spring time temperatures to be particularly warm. …If La Niña persists through February into the snow ablation season, then it can contribute to low snowpacks. [In this case, ablation refers to the removal of snow by wind, melting, evaporation, or sublimation.] La Niña spring times tend to be warm and windy and La Niña can generate some of these large snow-eater events in spring time. That can bring subsequent streamflows down even farther. So, one of the things we'll be looking for as we get into this winter is whether La Niña looks like it will persist all the way into the winter and into the spring (April–May timeframe), or whether it's demise will come early, like last year's El Niño, which [fizzled] early in the season.

Castro: As a rejoinder to that, if the whole dry scenario plays out, the fire danger in May and June is going to be pretty critical around here.

Garfin: Let's jump back to the questions about the Upper Colorado and the Upper Rio Grande basins, where all that good snowfall should generate something. Klaus had mentioned that usually the Upper Colorado River Basin will be wet, but right now a couple of the tools are pointing to really dry conditions throughout the winter.

Gutzler: Well, we know very clearly from just looking at streamflow composites that there's a very strong expression of the ENSO [El Niño Southern Oscillation] cycle on subsequent years' streamflow for the rivers that have their headwaters in the southern Rockies. That is entirely consistent with the precipitation signal, and in a secondary way consistent with the tendency for warm springs. Both of those, during La Niña winters, tend to make streamflows lower in the following years, this year being spring 2008. Given the way this La Niña is developing, in what looks like a traditional way with its spatial pattern looking very much like classic La Niña composites, I don't see any reasons to deviate from a prediction of low streamflows next year.

Castro: You also need to consider water usage. Usage goes up as well if there are drier conditions and if it's warmer.

Wolter: The one benefit of the northward extension of this track might be, in mid-winter at least, that it may not be very windy. We often actually get quite a few mid-winter windstorm events in Colorado with La Niña, and if the whole storm track shifts a bit more to the north to Wyoming and Montana, even into Canada, we may actually have less frequent windstorms. That doesn't really have very much bearing on the mid-winter snowpack, but when you get into February-March, it can play a role. …With grassy surfaces, even though you may have low temperatures, snow sublimates and simply disappears if you blow it around a lot. That's a very common way in which southern Wyoming loses snowpack. In the mountains, snow gets scoured above the tree line. Below the tree-line you get the snow off the trees, so that changes the albedo and helps warm up the air a bit earlier. [Albedo is the fraction of solar radiation that is reflected from a surface. Albedo is higher for a white, reflective snow surface than for a dark, heat-absorbing forested surface].

Garfin: Is there a tipping point at which we could definitely kiss any hope of winter-spring precipitation goodbye?

Wolter: It depends on where you go. In Arizona, my guess is that it would be very unusual to get much relief in March–April…. If you go into the Upper Colorado River Basin, March and April are still very significant snowfall months. There is that little piece of hope that if this La Niña, for whatever reason, would be short-lived, if it does

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Roundtable, continued

play itself out rather quickly, we might get a bit of a rebound in the spring. In sixty years of climate data, I've found only one case where we went from El Niño into a La Niña and right back into an El Niño within two years, and that was from 1963–64 to 1965–66. The spring of '65 was indeed a pretty decent recovery case, but that's one out of eight or ten cases. …And of course, there's the January window of opportunity. If that doesn't come through, then the dry mid-winter forecast will look like it'll be on track.

Garfin: Actually, in the spring of 1999, in at least southern Arizona, we had a snowfall. That actually put a damper on what looked like was going to be a fairly robust fire season.

Wolter: That was an interesting case. April is a very peculiar month. We've had more than one case where, with a full-blown La Niña situation, April was the one month during the spring season that was wet. It was true in 1999 in Colorado, and it was also true in 1971.

Castro: The general message to stakeholders is that it's probably going to be a drier-than-normal winter, and they should plan for that.

Gutzler: Fifteen or twenty years ago, our understanding of these ENSO cycles was such that we just think about a single event where we had some knowledge of a composite, and we would go with that [composite] as a seasonal forecast. What I think we've done over the last decade is realize, having seen more events and looked at them more carefully, that it's worth revisiting the La Niña forecast, say in midwinter, around the end of the calendar year.

Garfin: Have you seen any changes in the La Niña characteristics that you might ascribe to decadal variations or to climate change? Global warming, let's call it.

Wolter: We've had basically a lack of moderate to strong La Niña events since the mid 70s. …There was a fairly short event in early '88 that was over by mid-'89. Then we had the long-winded affair from summer of '98 to, depending on how you count it, early 2000 or 2001. That's about it. Compared to that, we've had very long-lasting, strong La Niñas, both in the 70s and the 50s. So there has been a change in the decadal behavior of La Niña events, but I would be very hesitant to attach that to, say, global change. …Despite the lack of La Niña events, it hasn't been just a transition to El Niño events; we've had a lot of neutral or complicated patterns where the cold anomalies were not where you would expect them. …There's a bit of a debate right now over the warmth, especially in the spring season, that we have been seeing in the last thirty years or so that's consistent with La Niña, but it's also consistent with global change, and it's also consistent with an earlier meltout of snowpack. How much of that will continue into the future and whether it will continue to accelerate or not, that's a matter of debate, I guess. We need to focus some research on that.

Gutzler: More than any year over the past few years, this looks as much or more like a classical ENSO-driven winter compared to just about anything I've seen recently. I would lean heavily on long-term composites that have been generated based on La Niña winters for guidance and really pay attention to that forcing.

Castro: I think there is a question as to whether the PDO [Pacific Decadal Oscillation] has changed since the late 1990s into the present. …If it has flipped back, then, as Klaus said, those are periods where we tend to have dry times in the Southwest during winter and then dry in the central U.S. Those kinds of times are when you have the biggest drought in the central U.S., like in the 30s, the 50s, and the 70s. Now the big debate is whether this latest prolonged drought is due to whether the PDO has flipped. We don't know.

Wolter: I agree 100 percent with Dave. It looks much more like a La Niña than anything we've seen in almost ten years, but there may be more going on that could influence it, and one thing we haven't mentioned so far is the Atlantic. The North Atlantic is still warm. The hurricane seasons have been disappointing, if you're trying to bet on hurricane damage on the coast, but actually this was another hurricane season above normal, it just didn't hit the U.S. That seems to have an influence on our climate too, and, unfortunately, not a positive influence. It seems to help dry us out a bit.

Castro: I don't know whether there is any agreement in the climate change community as to whether we go more toward an ENSO-like state or a La Niña-like state in the future.

Wolter: I would agree with that. If you look very carefully at the IPCC [Intergovernmental Panel on Climate Change] Fourth Assessment Report, there's actually a graph in there that shows…whether or not we're going to get more El Niño- or La Niña-like behavior, and the models are all over the place. Knowing which model to pick, we don't have much guidance at this point.

Garfin: Thank you all for taking the time here. This has been an interesting discussion.

Temperature (through 11/18/07)

Source: High Plains Regional Climate Center

Temperatures for the water year have averaged from the lower 70s degrees Fahrenheit in the southwestern deserts of Arizona to the 50s on the Colorado Plateau and across most of New Mexico (Figures 1a–b). Higher elevations have had temperatures in the 40s, and southern New Mexico has been in the upper 60s. This translates to a departure from average of 2–4 degrees F across the majority of both states. During the past thirty days, temperatures have been from 0 to 8 degrees F above average for both Arizona and New Mexico, with most of Arizona averaging 4 to 6 degrees F above average and most of New Mexico averaging 2 to 4 degrees F above average (Figures 1c–d). The cause of the unseasonably high temperatures is a strong high pressure ridge that has been present for most of the past month. Under high pressure, air sinks and warms by compression. Warmer air can hold more moisture as vapor, so condensation does not occur and clouds do not form. The resulting clear skies both enhance the warming and block low pressure storm systems. This is a typical La Niña pattern that may persist for much of the winter. In the past two days, the high pressure ridge has temporarily broken down and a weak low pressure system (cooler, rising air with clouds) moved through southern and central Arizona and New Mexico bringing isolated light showers. The high pressure will return briefly before another storm system moves through the west.

Figure 1a. Water year '07–'08 (through November 18, 2007) average temperature.

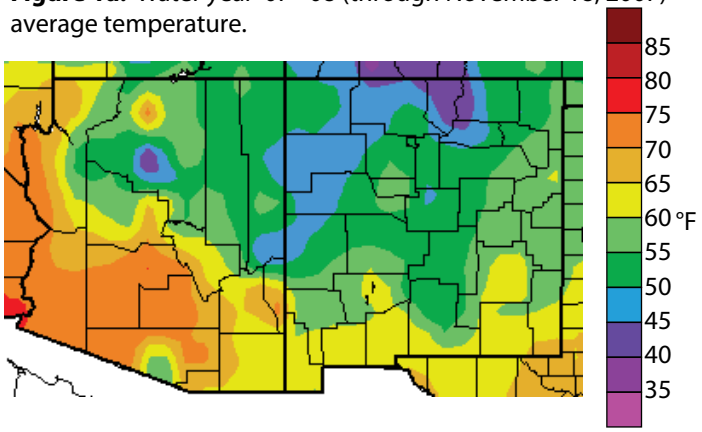


Figure 1b. Water year '07–'08 (through November 18, 2007) departure from average temperature.

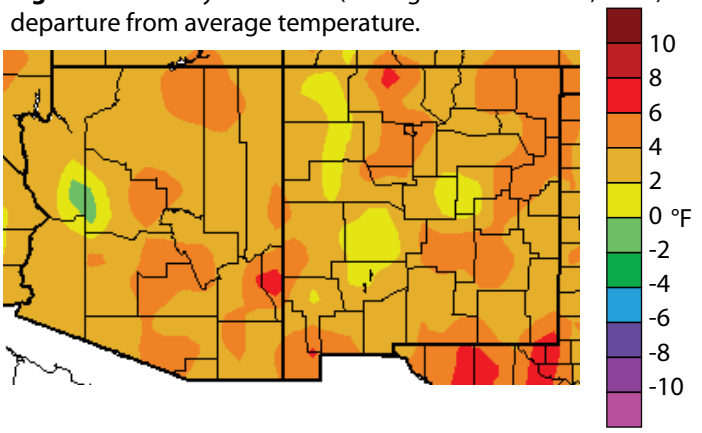


Figure 1c. Previous 30 days (October 20–November 18, 2007) departure from average temperature (interpolated).

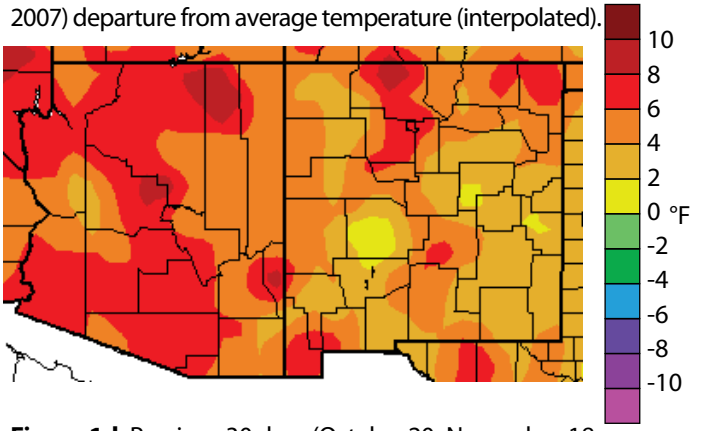
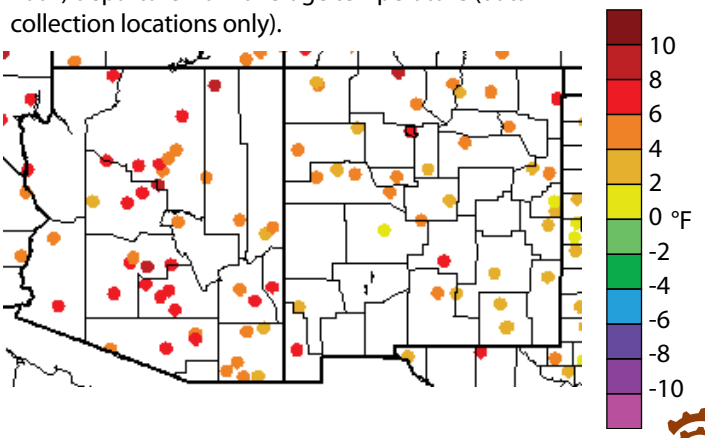


Figure 1d. Previous 30 days (October 20–November 18, 2007) departure from average temperature (data collection locations only).



Notes:

The water year begins on October 1 and ends on September 30 of the following year. Water year is more commonly used in association with precipitation; water year temperature can be used to measure the temperatures associated with the hydrological activity during the water year.

Average refers to the arithmetic mean of annual data from 1971–2000. Departure from average temperature is calculated by subtracting current data from the average. The result can be positive or negative.

The continuous color maps (Figures 1a, 1b, 1c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. The dots in Figure 1d show data values for individual stations. Interpolation procedures can cause aberrant values in data-sparse regions.

These are experimental products from the High Plains Regional Climate Center.

On the Web:

For these and other temperature maps, visit:
http://www.hprcc.unl.edu/products/current.html

For information on temperature and precipitation trends, visit:
http://www.cpc.ncep.noaa.gov/trndtext.shtml

Precipitation (through 11/20/07)

Source: High Plains Regional Climate Center

The water year is starting out extremely dry for Arizona and New Mexico (Figures 2a–b). Since the start of the water year, both states have received less than 1 inch except at the highest elevations of the White Mountains in east-central Arizona. In the past thirty days, both states have received less than a tenth of an inch of rainfall (Figures 2c–d). Northeastern New Mexico and northwestern Arizona have received 0.50 inches or less. The precipitation that has fallen has been restricted to the higher elevations and northern portions of the states, as weak cold fronts have moved through. So far, the pattern of strong high pressure over the West, typical during La Niña events, has dominated the circulation. Fortunately, October tends to be a relatively dry month, so many areas of Arizona and New Mexico are at less than 50 percent of average precipitation. The majority of both states are at 5 percent of average precipitation. This is a significant problem because autumn precipitation can saturate the soil, which prevents the snowpack from soaking into the soil during the spring melt, allowing a higher percentage of the snowpack to reach the reservoirs. Since snowpack may be very limited this year, it is important that as much of it as possible reaches the reservoirs in spring.

Figure 2a. Water year '07–'08 (through November 20, 2007) percent of average precipitation (interpolated).

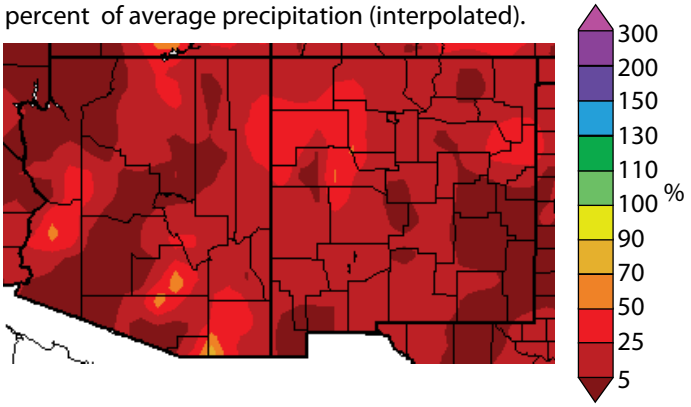


Figure 2b. Water year '07–'08 (through November 20, 2007) percent of average precipitation (data collection locations only).

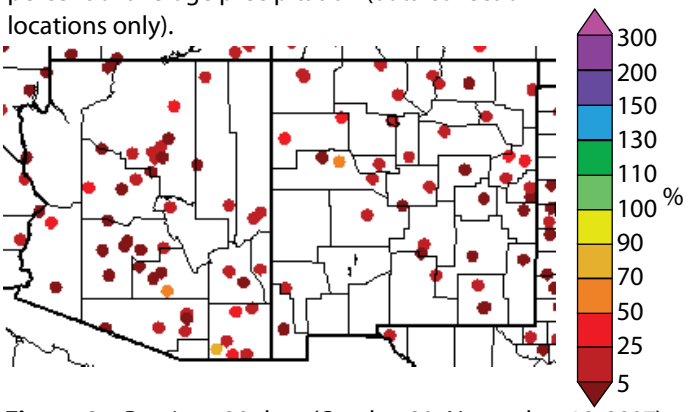


Figure 2c. Previous 30 days (October 20–November 18, 2007) percent of average precipitation (interpolated).

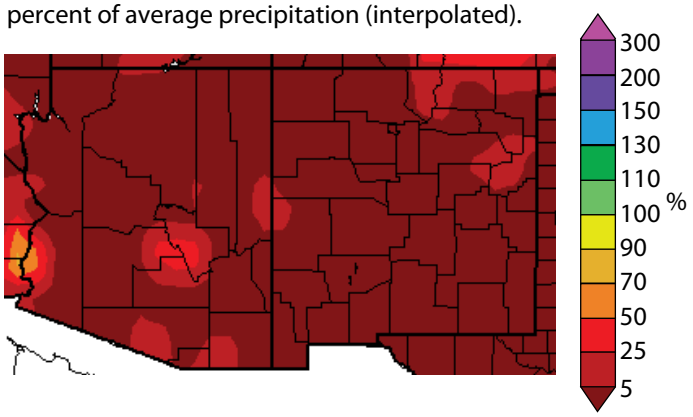
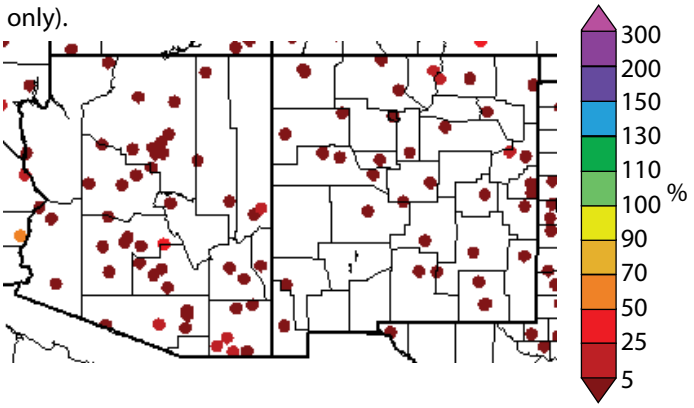


Figure 2d. Previous 30 days (October 20–November 18, 2007) percent of average precipitation (data collection locations only).



Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2007, we are in the 2008 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year.

Average refers to the arithmetic mean of annual data from 1971–2000. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100.

The continuous color maps (Figures 2a, 2c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

The dots in Figures 2b and 2d show data values for individual meteorological stations.

On the Web:

For these and other precipitation maps, visit:
http://www.hprcc.unl.edu/products/current.html

For National Climatic Data Center monthly precipitation and drought reports for Arizona, New Mexico, and the Southwest region, visit: http://lwf.ncdc.noaa.gov/oa/climate/research/2003/perspectives.html#monthly

U.S. Drought Monitor

(released 11/15/07)

Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

Drought conditions continue to persist across much of Arizona and have worsened across portions of New Mexico in the past month (Figure 3). Abnormally dry to extreme drought conditions are present over 92 percent of Arizona; more than 27 percent of this area alone is in the extreme category. Conditions are worse in western Arizona, while a small portion of southeastern Arizona remains drought free due to near-average summer precipitation. Below-average precipitation in October and November has caused the abnormally dry drought designation to expand through east central Arizona into western New Mexico. Abnormally dry conditions have also expanded across northeastern New Mexico, with more than 32 percent of the state now under this drought category.

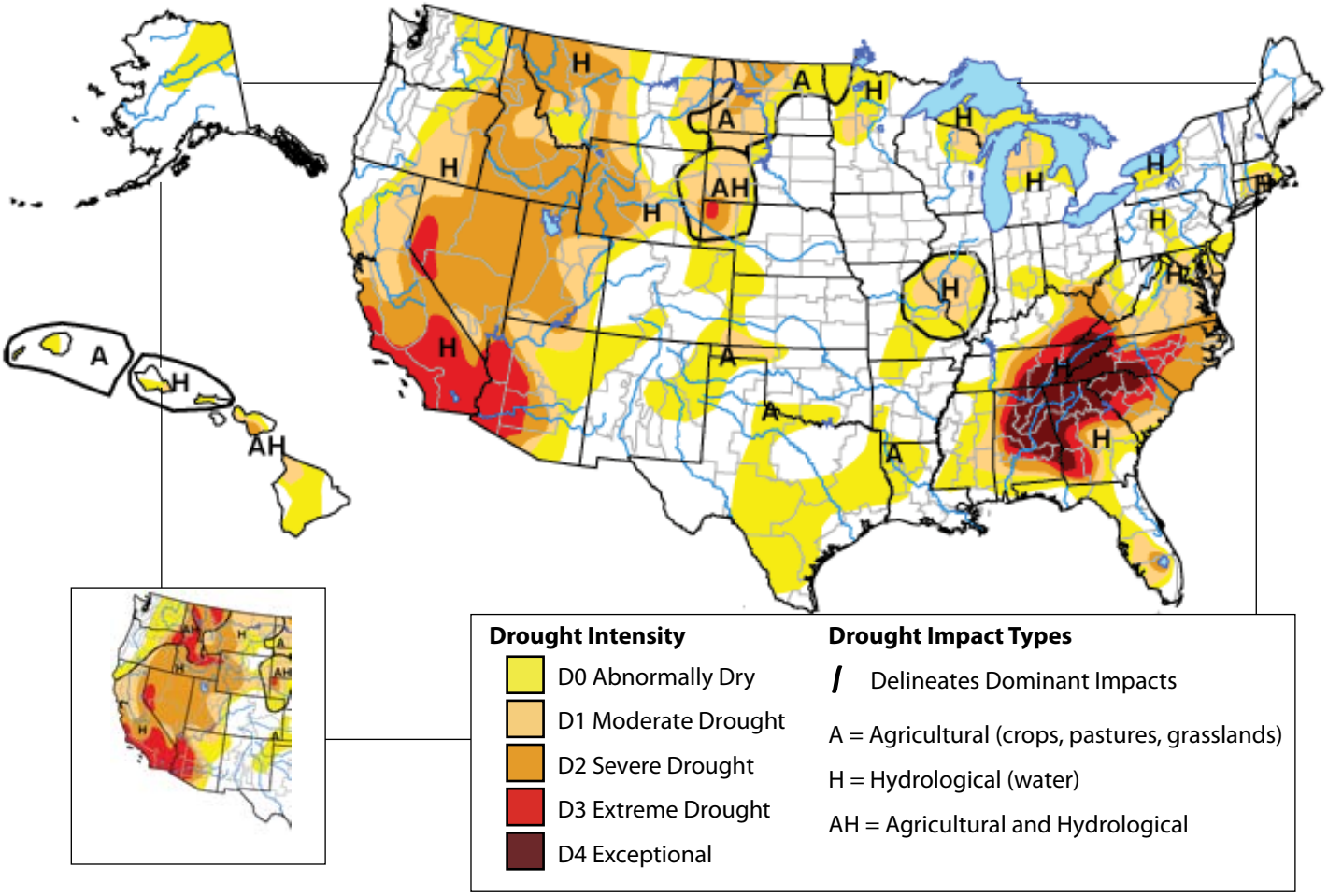
The current La Niña event is expected to persist through this winter and bring below-average precipitation and deepening drought conditions to the Southwest.

Notes:

The U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The inset (lower left) shows the western United States from the previous month's map.

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of the several agencies; the author of this monitor is Douglas Le Comte, CPC/NOAA.

Figure 3. Drought Monitor released November 15, 2007 (full size) and October 18, 2007 (inset, lower left).



On the Web:

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website: http://www.drought.unl.edu/dm/monitor.html

Arizona Drought Status

(through 10/31/07)

Source: Arizona Department of Water Resources

Short-term conditions improved slightly across Arizona, while long-term conditions remained largely unchanged (Figures 4a–b). The October update of the Arizona Drought Monitor Report depicts the largest improvements in short-term conditions across northwestern Arizona. Above-average precipitation in the early part of the monsoon season as well as several frontal storms in late September and October helped boost precipitation levels and lessen local drought impacts. The Agua Fria and Santa Cruz River watersheds saw below-average precipitation over the last several months and remain at the moderate drought status level, while the rest of the state is at abnormally dry to normal levels. Most of Arizona remains at moderate to severe long-term drought levels again this month. The Salt River watershed was the only change this month in long-term drought, sliding from the moderate to severe level.

The improvements in short-term conditions over northwest Arizona are supported with recent drought impact reports from Yavapai County. Local observers in the Prescott area noted the positive impacts of widespread precipitation in September. The precipitation helped fill stock tanks across the area and helped spur some late grass production for livestock forage. Observers also noted a late burst in wildflowers after the early fall rains. Concern still exists that these short-term improvements could be quickly reversed if upcoming winter rainfall is below average, as is expected with the current La Niña event.

Figure 4a. Arizona short-term drought status for October 2007.

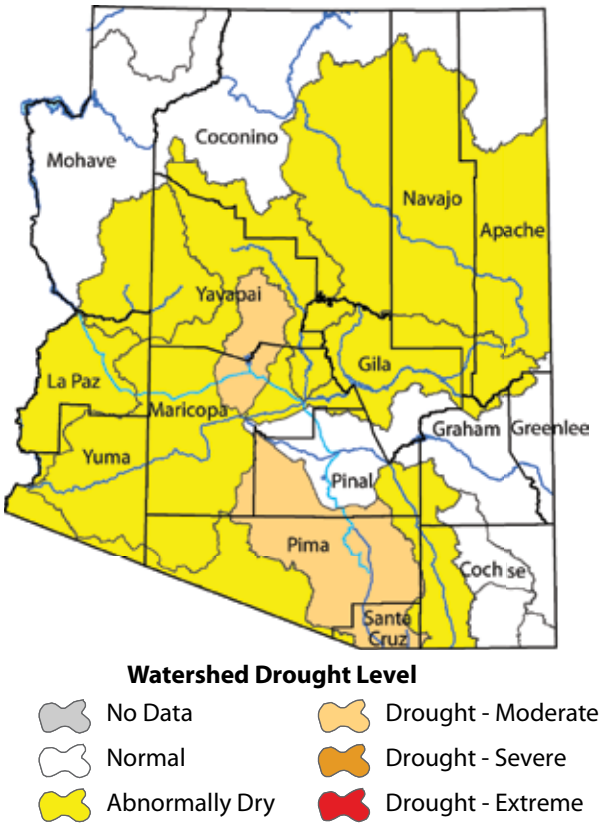
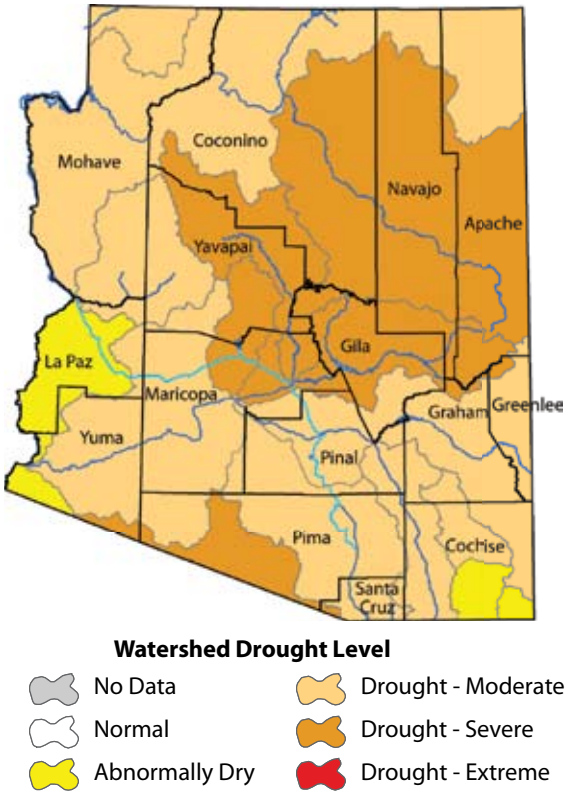


Figure 4b. Arizona long-term drought status for October 2007.



Notes:

The Arizona drought status maps are produced monthly by the Arizona Drought Preparedness Plan Monitoring Technical Committee. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 4a shows short-term or meteorological drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months). Figure 4b refers to long-term drought, sometimes known as hydrological drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfall (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, and groundwater). These maps are delineated by river basins (wavy gray lines) and counties (straight black lines).

On the Web:

For the most current Arizona drought status maps, visit:
http://www.azwater.gov/dwr/drought/DroughtStatus.html

New Mexico Drought Status

(through 10/31/07)

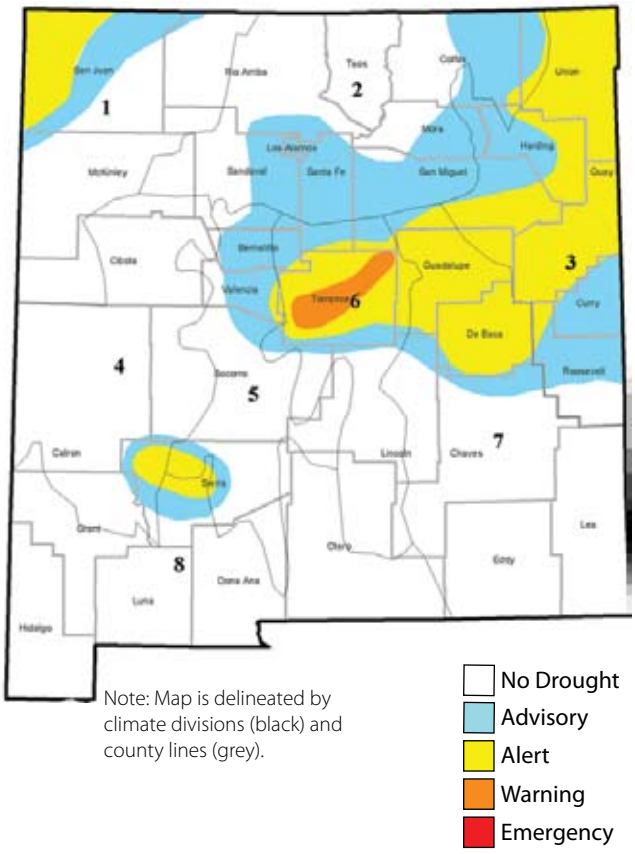
Source: New Mexico State Drought Monitoring Committee

Dry conditions throughout early autumn have caused an expansion of alert conditions in the north-central and north-eastern parts of New Mexico (Figure 5). Conditions in Torrance County have been upgraded to a warning status, due to short-term above-average temperatures and continued dryness on the three- to seven-month timescale. Conversely, above-average precipitation in the northern mountains during September alleviated drought conditions in most of Rio Arriba and Los Alamos counties. With the exceptions of the Four Corners region and northwest Sierra County, much of western and southern New Mexico continue to be drought free. However, the current La Niña event may bring below-average winter precipitation to New Mexico, promoting expansion of drought conditions back into New Mexico through the spring season.

The developing drought conditions have impacted soil moisture. Conditions in the northwest and northeast part of the state were predominantly in the short to very short soil moisture category. These levels indicate that soil moisture supplies are significantly less than what is necessary to support normal crop development and growth of agricultural crops in these regions.

This month's map is based on conditions through the end of September/early October. The New Mexico Drought Monitoring Work Group does not typically meet or release reports during November and December. However, the group will be monitoring conditions due to the expected dryness associated with the La Niña event and will release updates if necessary.

Figure 5. Short-term drought map based on meteorological conditions for October 2007.



Note: Map is delineated by climate divisions (black) and county lines (grey).

Notes:

The New Mexico drought status map is produced monthly by the New Mexico State Drought Monitoring Committee. When near-normal conditions exist, they are updated quarterly. The map is based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 5 shows short-term or *meteorological* drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months).

On the Web:

For the most current meteorological drought status map, visit:
http://www.srh.noaa.gov/abq/feature/droughtinfo.htm

For the most current hydrological drought status map, visit:
http://www.nm.nrcs.usda.gov/snow/drought/drought.html

Arizona Reservoir Levels

(through 10/31/07)

Source: National Water and Climate Center

Storage declined in all Arizona reservoirs during the last month (Figure 6). Storage in lakes Powell and Mead is expected to continue declining through the spring 2008 snowmelt runoff season. Storage in the Salt and Verde River reservoirs declined by more than 50,000 acre-feet during the last month.

In water-related news, the Bureau of Reclamation released a final environmental impact statement on November 2 associated with shortage sharing agreements between the seven Colorado River Basin states: Arizona, New Mexico, California, Nevada, Utah, Colorado, and Wyoming. The proposed changes allow states to manage shortages with more flexibility than in the past, taking into account the needs of rapidly growing areas, such as southern Nevada. The full document is at http://www.usbr.gov/lc/region/programs/strategies/FEIS/index.html.

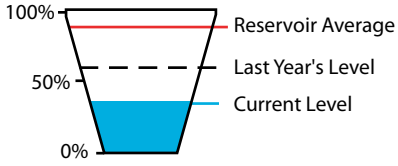
Notes:

The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (dotted line) and the 1971–2000 reservoir average (red line).

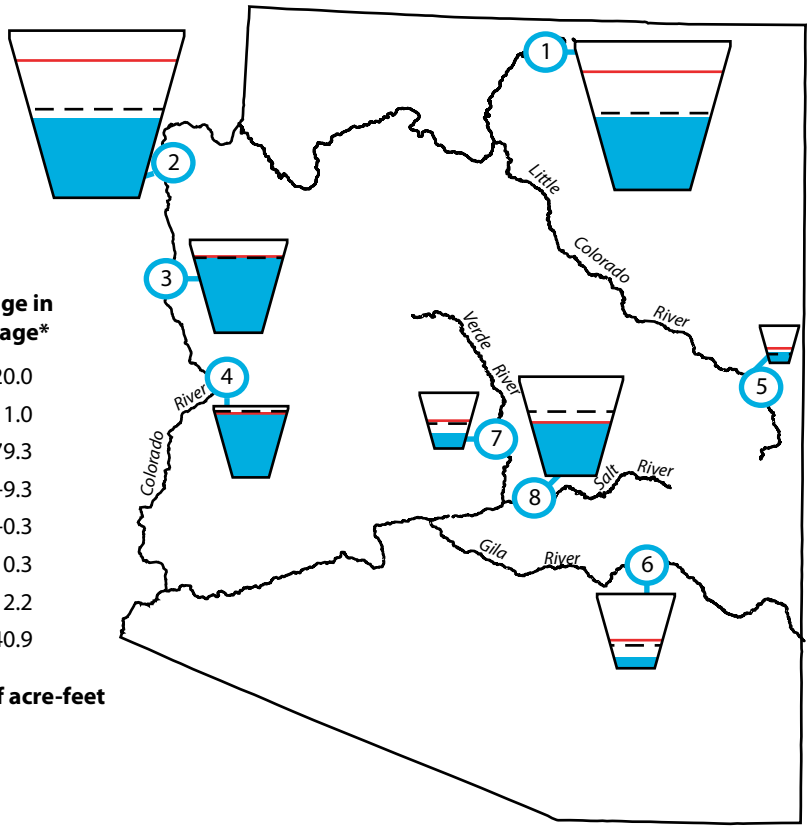
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Larry Martinez, NRCS, Larry.Martinez@az.usda.gov.

Figure 6. Arizona reservoir levels for October 2007 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



size of cups is representational of reservoir size, but not to scale



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Lake Powell	49%	11,809.0	24,322.0	-120.0
2. Lake Mead	48%	12,494.0	26,159.0	-11.0
3. Lake Mohave	81%	1,465.4	1,810.0	-79.3
4. Lake Havasu	92%	566.4	619.0	-9.3
5. Lyman Reservoir	27%	8.2	30.0	-0.3
6. San Carlos	15%	129.9	875.0	-10.3
7. Verde River System	27%	76.8	287.4	-12.2
8. Salt River System	53%	1,065.5	2,025.8	-40.9

*** thousands of acre-feet**

On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

New Mexico Reservoir Levels

(through 10/31/07)

Source: National Water and Climate Center

Storage in most New Mexico reservoirs declined since last month, with the greatest declines occurring at Elephant Butte, Brantley, and Conchas reservoirs (Figure 7). Storage increased by 5,400 acre-feet at Abiquiu Reservoir.

New Mexico Governor Bill Richardson appropriated $700,000 to provide residents in rural northern New Mexico with access to safe drinking water (Associated Press, November 8). In some areas, residents have been hauling water to areas threatened by nitrate, rust, and chemical contamination.

A new Santa Fe County employee assigned to monitor and enforce conservation ordinances outlined her plans for county commissioners on October 30 (*Santa Fe New Mexican*, November 6). During the last five years, the county has required all businesses to install low-flow toilets and shower heads and required builders to install water-saving devices, but the lack of qualified employees has stalled enforcement efforts.

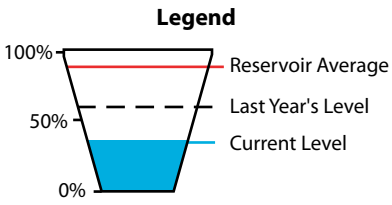
Notes:

The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (dotted line) and the 1971–2000 reservoir average (red line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Larry Martinez, NRCS, Larry.Martinez@az.usda.gov.

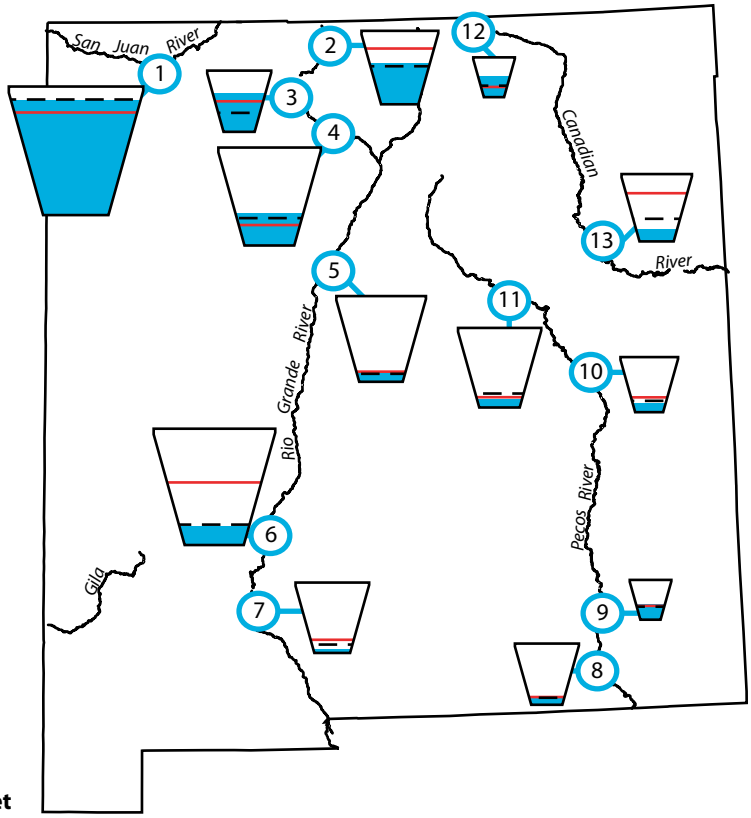
Figure 7. New Mexico reservoir levels for October 2007 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



size of cups is representational of reservoir size, but not to scale

Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	89%	1,508.6	1,696.0	-1.3
2. Heron	56%	223.5	400.0	-1.2
3. El Vado	63%	122.2	195.0	-2.7
4. Abiquiu	33%	181.4	554.5	5.4
5. Cochiti	10%	49.8	491.0	-0.1
6. Elephant Butte	15%	324.9	2,195.0	-37.3
7. Caballo	6%	20.5	332.0	4.1
8. Brantley	12%	17.9	147.5	-9.1
9. Lake Avalon	38%	1.5	4.0	0.2
10. Sumner	17%	17.5	102.0	-3.7
11. Santa Rosa	11%	49.9	438.3	0.4
12. Costilla	52%	8.3	16.0	0.6
13. Conchas	17%	43.6	254.2	-8.9

*** thousands of acre-feet**



On the Web:

Portions of the information provided in this figure can be accessed at the NRCS website:
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

Temperature Outlook

(December 2007–May 2008)

Source: NOAA Climate Prediction Center (CPC)

This month's NOAA-CPC long-lead temperature forecasts predict an increased likelihood of above-average temperatures in all but the northernmost portions of the United States from December 2007–May 2008 (Figures 8a–d). For New England, the Northern Plains, Northern Rockies, and Pacific Northwest, forecasts indicate either average temperatures or equal chances of below-average, average, and above-average temperatures during that period. Arizona and New Mexico are particularly likely to experience above-average temperatures through the late winter and early spring months. This pattern reflects current moderate to strong La Niña conditions that are now expected to be moderate for at least the next three months.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average temperature, but not the magnitude of such variation. The numbers on the maps do not refer to degrees of temperature.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC temperature outlook, areas with light brown shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average temperature. A shade darker brown indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average temperature, and so on.

Equal Chances (EC) indicates areas where the reliability (i.e., 'skill') of the forecast is poor; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 8a. Long-lead national temperature forecast for December 2007–February 2008.

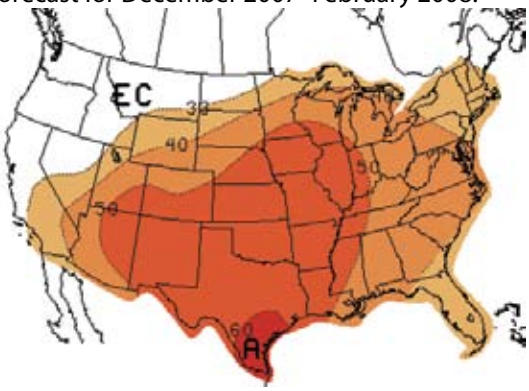


Figure8b. Long-lead national temperature forecast for January–March 2008.

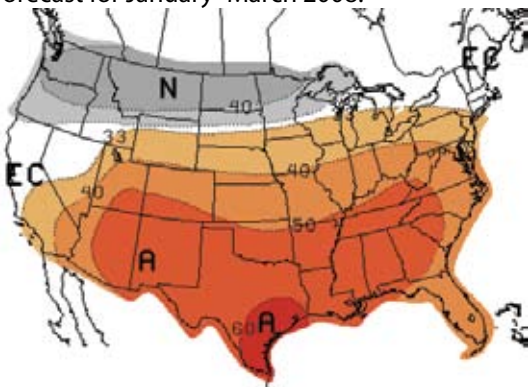


Figure 8c. Long-lead national temperature forecast for February–April 2008.

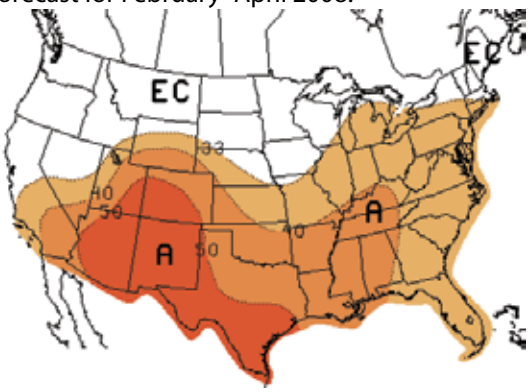
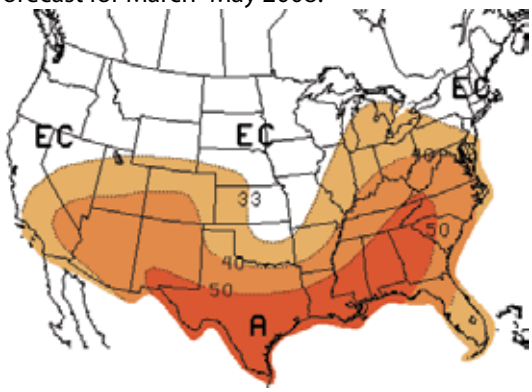


Figure 8d. Long-lead national temperature forecast for March–May 2008.



N=Near Normal
- 40.0–49.9%
- 33.3–39.9%

A= Above
- 60.0–69.9%
- 50.0–59.9%
- 40.0–49.9%
- 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
(note that this website has many graphics and may load slowly on your computer)

For IRI forecasts, visit:
http://iri.columbia.edu/climate/forecast/net_asmt/

Precipitation Outlook

(December 2007–May 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC forecasts for December 2007–May 2008 continue to reflect an ongoing La Niña pattern in the tropical Pacific: below-average precipitation is predicted across much of the southern United States and especially the Southwest and Southeast, and above-average precipitation is predicted for the Pacific Northwest states and the Northern Rockies (Figures 9a–d). As in previous forecasts, there is also an area of predicted above-average precipitation that centers over the Great Lakes and Ohio River Valley for December through April. La Niña conditions are now considered to be moderate to strong and are expected to remain in at least the moderate category for the next three months before weakening.

Notes:

These outlooks predict the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation.

The NOAA-CPC outlooks are a 3-category forecast. As a starting point, the 1971–2000 climate record is divided into 3 categories, each with a 33.3 percent chance of occurring (i.e., equal chances, EC). The forecast indicates the likelihood of one of the extremes—above-average (A) or below-average (B)—with a corresponding adjustment to the other extreme category; the "average" category is preserved at 33.3 likelihood, unless the forecast is very strong.

Thus, using the NOAA-CPC precipitation outlook, areas with light green shading display a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. A shade darker green indicates a 40.0–50.0 percent chance of above-average, a 33.3 percent chance of average, and a 16.7–26.6 percent chance of below-average precipitation, and so on.

Equal Chances (EC) indicates areas where the reliability (i.e., 'skill') of the forecast is poor; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 9a. Long-lead national precipitation forecast for December 2007–February 2008.

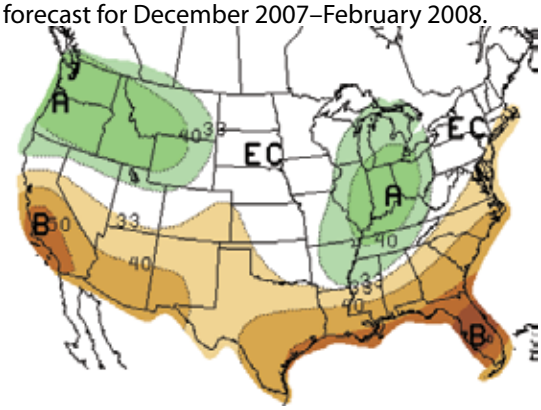


Figure 9b. Long-lead national precipitation forecast for January–March 2008.

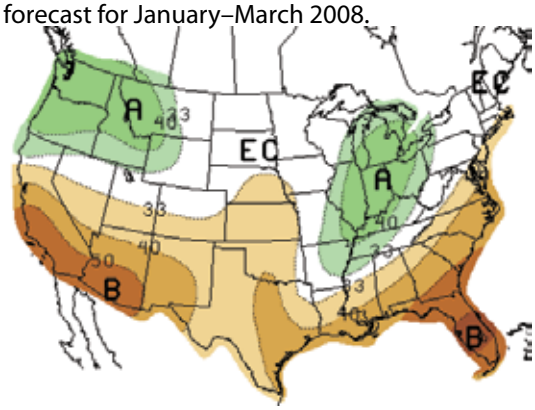


Figure 9c. Long-lead national precipitation forecast for February–April 2008.

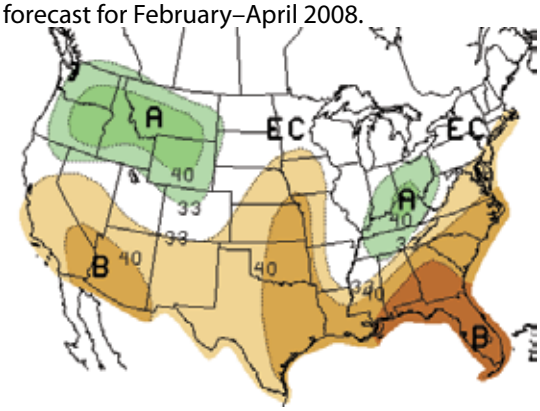
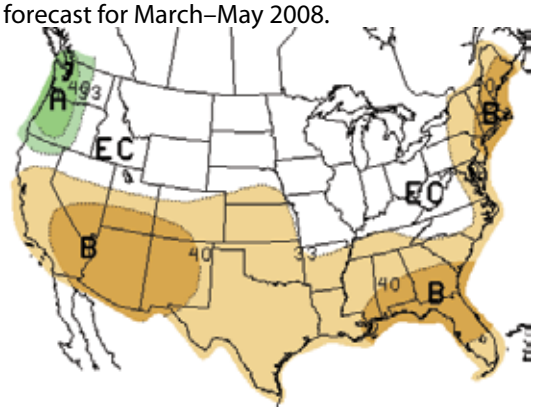


Figure 9d. Long-lead national precipitation forecast for March–May 2008.



A= Above
- 40.0–49.9%
- 33.3–39.9%

B= Below
- 33.3–39.9%
- 40.0–49.9%
- 50.0–59.9%
- 60.0–69.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
(note that this website has many graphics and may load slowly on your computer)

For IRI forecasts, visit:
http://iri.columbia.edu/climate/forecast/net_asmt/

Seasonal Drought Outlook
(through February 2008)

Source: NOAA Climate Prediction Center (CPC)

The latest NOAA Seasonal Drought Outlook predicts that drought will develop across eastern Arizona and New Mexico and persist or intensify in western Arizona (Figure 10). The forecast is based primarily on the strengthening and expected persistence of La Niña conditions through early 2008 (see feature article beginning on page 3). Recent storm tracks have set up a classic La Niña pattern of below-average precipitation in Arizona and New Mexico and above-average precipitation in the Pacific Northwest. In particular, enhanced drought conditions could develop in northeastern New Mexico during the upcoming months. Though not shown in the Southwest Climate Outlook, experimental precipitation forecasts from the International Research Institute for Climate and Society indicate increased chances of below-average precipitation for northern Sonora and Chihuahua in Mexico.

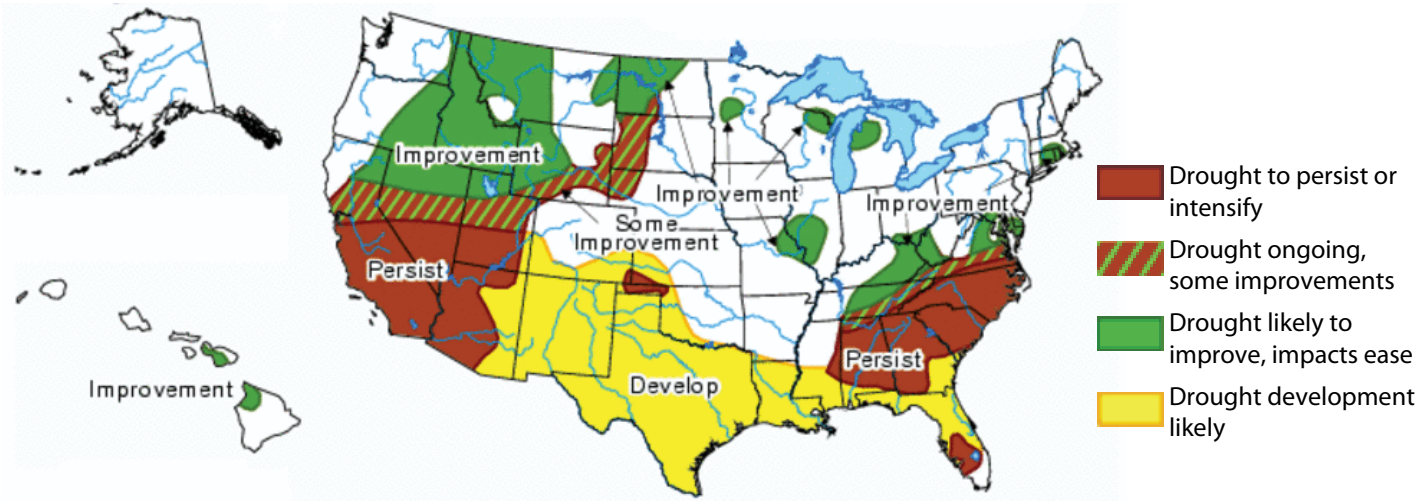
If the forecast pans out, Arizona will experience its third consecutive dry winter. Winter moisture is critical for replenishing surface and groundwater supplies and for winter rangeland forage. Furthermore, the lack of adequate water during the spring and early summer months due to insufficient winter precipitation can severely affect wildlife reproduction. Most of New Mexico received adequate 2006–07 winter precipitation; however, a desiccating La Niña winter could portend increased threats to endangered fish and wildlife if streamflows are low, as they often are during La Niña winters.

The U.S. Drought Portal (http://www.drought.gov) was launched on November 1. The portal is part of the National Integrated Drought Information System, which was funded by the president and Congress earlier this year. The portal coordinates access to key drought information from a variety of sources. Topics include drought planning, current conditions, forecasts, drought impacts, education, and research. The portal will provide access to an ever-increasing body of substantial drought information, including local and state drought monitoring and planning sites.

Notes:

The delineated areas in the Seasonal Drought Outlook (Figure 10) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 10. Seasonal drought outlook through February 2008 (released November 15, 2007).



On the Web:

For more information, visit:
http://www.drought.noaa.gov/

El Niño Status and Forecast

Sources: NOAA Climate Prediction Center (CPC), International Research Institute for Climate and Society (IRI)

The 2007 La Niña is presently in full swing across the equatorial Pacific Ocean. The NOAA Climate Prediction Center reports that the current La Niña event continued to strengthen in October with much cooler-than-average sea surface temperatures (SSTs) extending from the eastern Pacific Ocean out to the International Date Line. SSTs are 1–2 degrees Celsius below average across much of the eastern Pacific with water temperatures measuring 2–6 degrees C below average just below the surface. The atmosphere has also noticed La Niña and responded with stronger-than-average low-level easterly winds, upper-level westerly winds, and increasing Southern Oscillation Index (SOI) values (Figure 11a). Also consistent with La Niña conditions is the present pattern of suppressed convection in the eastern Pacific and enhanced activity in the western Pacific.

The International Research Institute for Climate and Society (IRI) notes that recent conditions suggest that this La Niña may reach moderate strength if the magnitude of below-average SSTs is maintained over the next several months.

Notes:

Figure 11a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through October 2007. The SOI measures the atmospheric response to SST changes across the Pacific Ocean Basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

Figure 11b shows the International Research Institute for Climate Prediction (IRI) probabilistic El Niño-Southern Oscillation (ENSO) forecast for overlapping three month seasons. The forecast expresses the probabilities (chances) of the occurrence of three ocean conditions in the ENSO-sensitive Niño 3.4 region, as follows: El Niño, defined as the warmest 25 percent of Niño 3.4 sea-surface temperatures (SSTs) during the three month period in question; La Niña conditions, the coolest 25 percent of Niño 3.4 SSTs; and neutral conditions where SSTs fall within the remaining 50 percent of observations. The IRI probabilistic ENSO forecast is a subjective assessment of current model forecasts of Niño 3.4 SSTs that are made monthly. The forecast takes into account the indications of the individual forecast models (including expert knowledge of model skill), an average of the models, and other factors.

On the Web:

For a technical discussion of current El Niño conditions, visit:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

For more information about El Niño and to access graphics similar to the figures on this page, visit:
http://iri.columbia.edu/climate/ENSO/

Forecasts indicate that there is a high probability (97 percent chance) that at least weak La Niña conditions will persist through the November–January season (Figure 11b). La Niña events typically reach their peak strength in the early winter season and decline through the spring. Forecasts expect this event to persist through mid-winter, but it is not clear how quickly the event may end with a return to neutral conditions in the spring. Nonetheless, the current event is expected to impact the Southwest U.S. this winter with below-average precipitation and above-average temperatures.

Figure 11a. The standardized values of the Southern Oscillation Index from January 1980–November 2007. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).

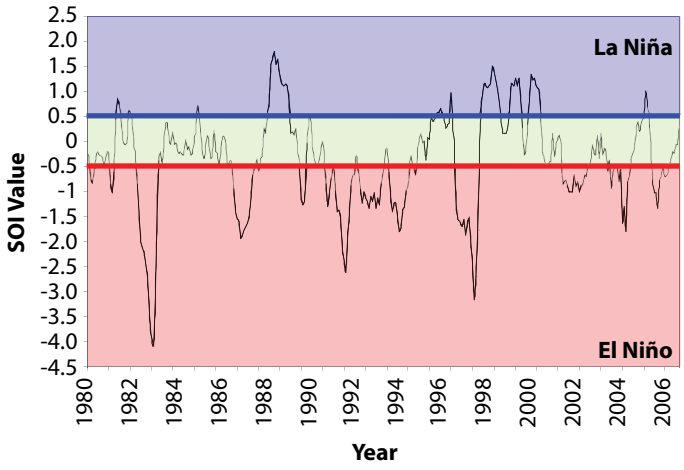
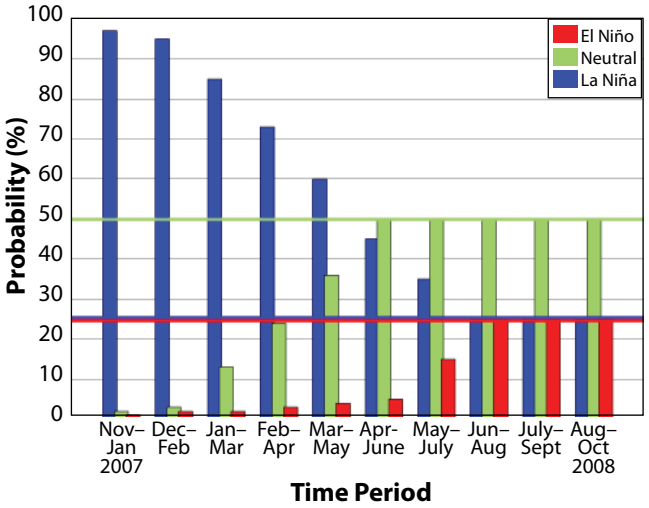


Figure 11b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released November 15, 2007). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



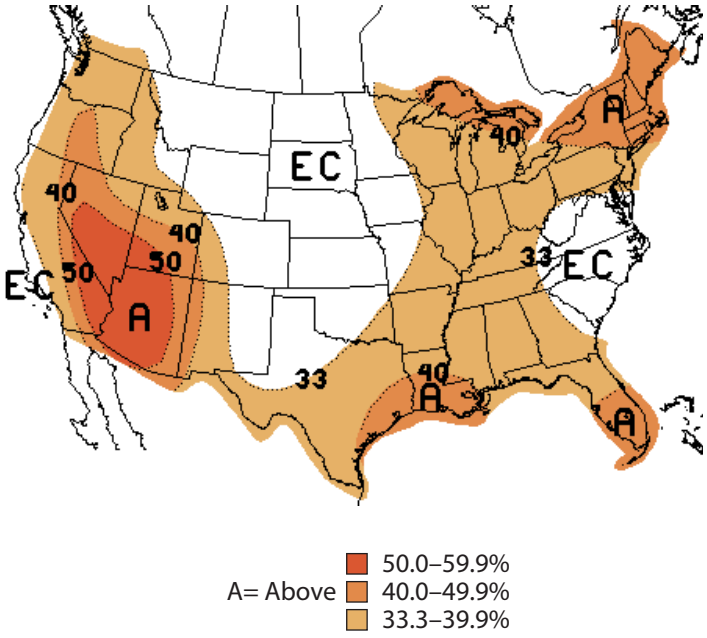
Temperature Verification

(August–October 2007)

Source: NOAA Climate Prediction Center (CPC)

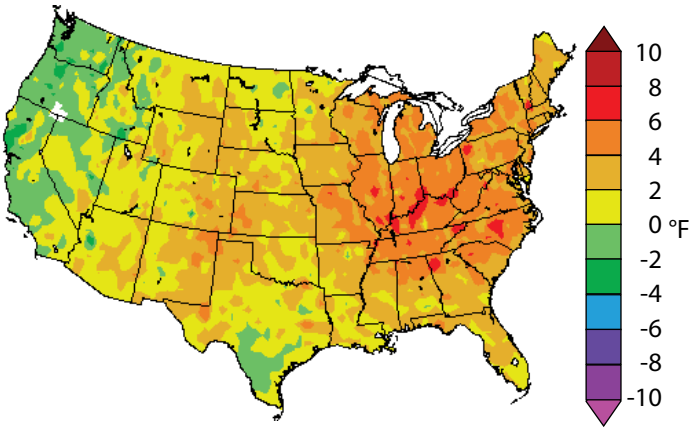
The NOAA-CPC seasonal temperature outlook for August–October 2007 predicted an increased likelihood of above-average temperatures across most of the West and especially Arizona, southern Nevada, and southern Utah (Figure 12a). An increased probability of above-average temperatures was also forecast for the Gulf and Atlantic coasts. Observed conditions were somewhat different, as the eastern third of the country experienced the greatest departure from normal temperatures, generally 2–8 degrees F above the long-term average (Figure 12b). The Rockies and Great Plains regions experienced near-normal to slightly above-normal temperatures (-2 to 6 degrees F), while most of the Pacific Coast, including the Pacific Northwest, saw temperatures at to slightly below normal (0 to -4 degrees F). Across most of Arizona and New Mexico, temperatures were 0 to 6 degrees F above normal.

Figure 12a. Long-lead U.S. temperature forecast for August –October 2007 (issued July 2007).



EC= Equal chances. No forecasted anomalies.

Figure 12b. Average temperature departure (in degrees F) for August–October 2007.



Notes:

Figure 12a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months August–October 2007. This forecast was made in July 2007.

The outlook predicts the likelihood (chance) of above-average, average, and below-average temperature, but not the magnitude of such variation. The numbers on the maps do not refer to degrees of temperature.

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average temperature. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 12b shows the observed departure of temperature (degrees F) from the average for the August–October 2007 period. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps. The temperature departures do not represent probability classes as in the forecast maps, so they are not strictly comparable. They do provide us with some idea of how well the forecast performed. In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Precipitation Verification

(August–October 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal precipitation outlook for August–October 2007 indicated an increased probability of below-average precipitation in the Pacific Northwest and portions of the Northern Rockies (Figure 13a). An increased chance of above-average precipitation was forecast for the Gulf and Atlantic coasts, while the forecast showed equal chances of below-average, average, and above-average precipitation for the Southwest and the remainder of the country. Observed conditions over the period were quite spotty (Figure 13b). In the Pacific Northwest, observed conditions in most of Washington were dry, as predicted, while most of Oregon saw above-average rainfall. Contrary to predictions, most of the southwestern and southeastern United States experienced below-average precipitation. Across most of Arizona and New Mexico, precipitation was less than 90 percent of normal. Western Arizona and east-central New Mexico were the dry spots in that region, with less then 50 percent of normal observed precipitation.

Figure 13a. Long-lead U.S. precipitation forecast for August–October 2007 (issued July 2007).

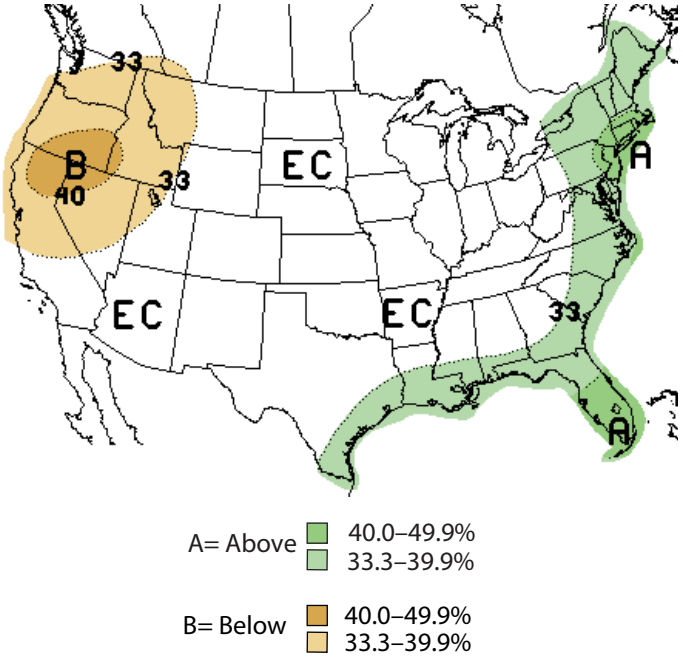
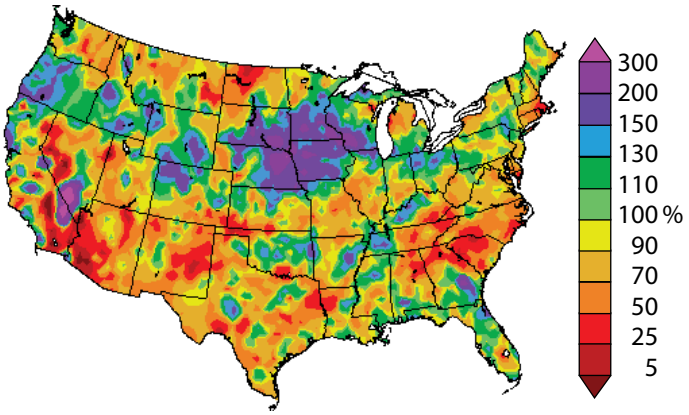


Figure 13b. Percent of average precipitation observed from August–October 2007.



Notes:

Figure 13a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months August–October 2007. This forecast was made in July 2007.

The outlook predicts the likelihood (chance) of above-average, average, and below-average precipitation, but not the magnitude of such variation. The numbers on the maps do not refer to inches of precipitation. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average precipitation. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is a 33.3–39.9 percent chance of above-average, a 33.3 percent chance of average, and a 26.7–33.3 percent chance of below-average precipitation. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 13b shows the observed percent of average precipitation for August–October 2007. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps. The observed precipitation amounts do not represent probability classes as in the forecast maps, so they are not strictly comparable, but they do provide us with some idea of how well the forecast performed.

In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html